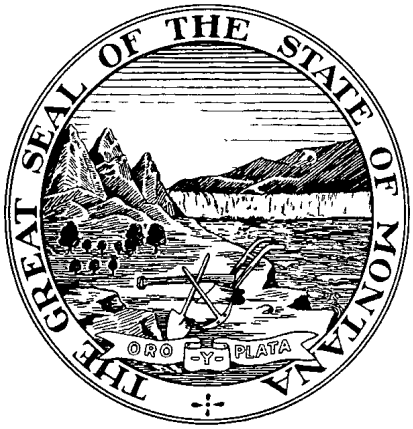

ELECTRICAL INFORMATION

2002 NEC Edition

MONTANA DEPARTMENT OF LABOR AND INDUSTRY

BUSINESS STANDARDS DIVISION

BUILDING CODES BUREAU
PO BOX 200517
HELENA, MONTANA 59620-0517

(406) 841-2040 -- General Information
(406) 841-2047 -- Electrical Permits

Chapter 60
Building Code Standards
Part 6
Electrical Installations

50-60-601. Purpose. The purpose of this part is to protect the health and safety of the people of this state from the danger of electrically caused shocks, fires, and explosions; to protect property from the hazard of electrically caused fires and explosions; to establish a procedure for determining where and by whom electrical installations are to be made; and to insure that the electrical installations and electrical products made and sold in this state meet minimum safety standards.

50-60-602. Exceptions.

(1) This part does not apply to:

(a) the installation, alteration, or repair of electrical signal or communications equipment and traffic signals, street lighting, and other electrical traffic control devices owned or operated by a public utility, city, or county or the state;

(b) electrical installations on the premises of petroleum refineries, except a structure classified under chapter 7, section 701, group B, division 2, and chapter 9, section 901, group H, outside of process units, of the 1991 edition of the Uniform Building Code;

(c) mines and buildings on mine property regulated under Title 82, chapter 4, and subject to inspection under the Federal Mine Safety and Health Act; or

(d) the installation, alteration, or repair of low-voltage electrical signal and communications equipment and optical fiber cable.

(2) The inspection provisions of this part do not apply to regularly employed maintenance electricians doing maintenance work on the business premises of their employer nor do they apply to line work on the business premises of the employer or to ordinary and customary in-plant or

onsite installations, modifications, additions, or repairs.
(3) A person who plugs in an electrical appliance where an approved electrical outlet is already installed may not be considered as an installer.
(4) This part does not in any manner interfere with, hamper, preclude, or prohibit any vendor of any electrical appliance from selling, delivering, and connecting any electrical appliance if the connection does not necessitate the installation of electrical wiring of the structure where the appliance is to be connected.

50-60-603. Electrical codes to be adopted by department by rule.
(1) The department of labor and industry shall adopt rules relating to the installation of wires and equipment to convey electrical current and installations of apparatus to be operated by current, except as provided in 50-60-602.
(2) The department may adopt by reference the national fire protection association standard NFPA 70, national electrical code, in whole or in part, and may adopt rules more stringent than those in the national fire protection association standard NFPA 70, national electrical code.

50-60-604. Inspections – electrical permits – fees.
The department of labor and industry or an authorized representative or a municipality or county certified to perform an inspection pursuant to 50-60-302 shall inspect electrical installations, issue electrical permits for these installations, and establish and charge a reasonable and uniform fee for the inspections. The fee must be commensurate with the expense of providing the inspection and with appropriations for other purposes. As part of any inspection, the inspector shall require proof of licensure from any person who is required to be licensed who is involved with or, in the inspector's judgment, appears to be involved with electrical installations if the person is on the site. The inspector shall report any instance of license violation to the inspector's employing agency, and the employing agency shall m turn report the violation to the board of electricians.

50-60-605. Power supplier not to energize installation without electrical permit.

Individuals, firms, cooperatives, corporations, or municipalities selling electricity are power suppliers. Except for temporary connections that the department of labor and industry may authorize by rule for a period not exceeding 14 days without a preconnection inspection, power suppliers may not connect with or energize an electrical installation under this part unless the owner or a licensed electrical contractor has delivered to the power supplier an electrical permit covering the installation, issued by the department of labor and industry or a municipality or county certified to enforce the electrical code pursuant to 50-60-302.

50-60-607. Energizing electrical installation without permit – misdemeanor. Any person, partnership, company, firm, association, or corporation, other than a power supplier, that energizes an electrical installation under this part for which an electrical permit has not been issued by the department of labor and industry or a municipality or county certified to enforce the electrical code pursuant to 50-60-302 is guilty of a misdemeanor.

50-60-608. Injunction authorized. The use or installation of wires or equipment conveying electrical current or the use or installation of any apparatus operated by electrical current in violation of any provision of this part or a lawful order of a state or local government building official may be enjoined by a judge in the district court of the judicial district in which the wires, equipment, or apparatus is located.

Electrical Requirements

24.301.401 NATIONAL ELECTRICAL CODE
The department, by and through the Building Codes Bureau, adopts and incorporates by reference herein the National Fire Protection Association standard NFPA 70, National Electrical Code, 2002 Edition, referred to as the National Electrical Code unless another edition date is specifically stated. The National Electrical Code is a nationally recognized model code setting forth the minimum standards and requirements for electrical installations. A copy of the National Electrical Code may be obtained from the Building Codes Division, PO Box 200517, Helena, Montana 56920-0517 or the National Fire Protection Association, One Batterymarch Park, PO Box 9101, Quincy, MA 02269-9101.

24.301.411 WIRING STANDARDS

(1) The National Electrical Code is amended as follows:

(a) NEC ARTICLE 110.2 (SUPPLEMENTARY). When requested, complete wiring diagrams shall be provided.

(b) NEC ARTICLE 550.32(a): The allowable distance for service equipment from the exterior wall of a manufactured or mobile home is increased from 30 ft (9.14 m) to 50 ft (15.24 m).

(c) NEC ARTICLE 550.32(B)(2): Add the following: It shall be permissible to feed a manufactured (mobile) home with type SER cable when the service equipment is mounted on the exterior of the home. Physical protection of the cable is required, by enclosing the cable in an approved raceway where the cable is run on the outside of the home. The cable is to be properly supported and attached per Article 338 where installed under the home.

(d) NEC ARTICLE 760.1 (SUPPLEMENTARY). Smoke detectors shall be installed in any building or structure as required under the currently adopted International Building Code or International Residential Code, whichever applies, regardless of whether or not the building or structure is exempt by 50-60-102, MCA.

24.301.421 ELECTRICAL INSPECTORS

(1) Only persons appointed and certified by the department shall act as electrical inspectors to represent the state of Montana.

(2) The inspector shall give information as to the meaning or application of the code, but shall not lay out work or act as a consultant for contractors, electricians, owners, or users.

(3) State electrical inspectors shall not inspect any electrical work in which the inspector has any financial or personal interest, has been installed by him or by any electrical contractor by whom he is employed.

(4) State electrical inspectors shall have powers as are vested in them by the department, including but not limited to the power to make inspections and to ascertain that none of the provisions of the Electrical Safety Law, the National Electrical Code, as amended from time to time, or the rules of the section are being violated.

(5) State electrical inspectors shall have the right, during reasonable hours and after showing proper identification, to enter any building or premise in the discharge of his official duties to make any inspection or test of electrical equipment that is necessary to protect the public health, safety, and welfare.

24.301.431 ELECTRICAL PERMIT

(1) Except as provided by section 50-60-602, MCA, an electrical permit is required for any installation in any new construction or remodeling or repair.

(2) Prior to the commencement of any electrical installation, in an area where the electrical code is enforced by the department, the installer or owner shall submit an official request for electrical permit to the department in Helena with fee(s) as provided in ARM 24.301.461. Request for electrical permit forms will be made available by the department and may also be available at any power supplier or the electrical inspector. At the time of application for a permit, the applicant shall indicate on the application for a permit whether or not the applicant will be the permittee for the entire project. Owners shall designate which electrical contractor will be performing work on the project.

(a) The department may issue a provisional electrical permit authorizing electrical installations for a period not to exceed 14 days when the applicant remits an application with fees that

exceed the current fee required. The department will notify the applicant of the correct fee due and retain the original permit fee until the applicant remits the correct fee. If the applicant fails to remit the correct fee within 14 days, the department will return the incorrect fee and application and request the power supplier disconnect the electrical service until such time as the required electrical permit is issued.

(3) The term "owner" listed in ARM 24.301.431 applies to the owner doing electrical work on his own property or residence provided that said property or residence is maintained for his own use. The property or residence shall be intended for the owner's personal use and not built on speculation of resale or intended as rental property. On farm and ranch installations used in conjunction with an agricultural or livestock raising operation, the term "owner" applies to the owner, owner's agent and/or person(s) employed by the owner on a full time basis as a farm or ranch employee at the farm or ranch involved.

(4) A local government certified to enforce the electrical code may require, in addition to the electrical permit required by 50-60-605, MCA, the power supplier be provided with proof of an approved inspection before the power supplier can energize the electrical installation. The local government shall provide the power supplier with written notice of this requirement if it wishes to enforce this option.

(5) The requirements listed in section 50-60-605, MCA, requiring an "electrical permit" before the energizing of an electrical installation by a power supplier means the power supplier may energize said installation, before an inspection has been performed by the department, after issuing a power supplier limited service certificate or upon receipt of the power supplier's copy of the electrical permit issued by the department.

(6) Upon receipt of the application for an electrical permit with the applicable fee(s), the department will issue the official electrical permit covering the installation.

(7) The permittee shall be responsible for, and shall insure that, all work performed under the electrical permit meets the requirements of the state building code, including the National Electrical Code. No person shall allow any other person to do, or cause to be done, any work under an electrical permit issued to the permittee, except the permittee or his employees.

(8) Electrical permits on which the fees, as provided in ARM 24.301.461, are under $250 are valid for a period of 1 year from the date of issuance. Extensions of up to one year may be granted on a case by case basis by the bureau for good cause provided such extension is requested prior to expiration of the permit and payment is made of the renewal fee.
(9) The electrical permit is transferable one (1) time, with application for permit transfer being made in writing on forms provided by the bureau. The permit transfer shall be completed prior to the subsequent permittee commencing work under the permit.
(10) The exception to permit requirements listed in section 50-60-602(2), MCA, for regularly employed maintenance personnel doing maintenance work on the business premises applies to personnel on the regular payroll rather than personnel under contract. Maintenance work includes ordinary and customary in-plant or on-site installations, modification, additions, or repairs which shall be limited to: relamping fixtures, replacing ballasts, trouble shooting, motor controls, replacing motors, breakers, magnetic starters, in a kind-for-kind manner. Also included are connection of specific items or specialized equipment that can be directly connected to an existing branch circuit panel by means of factory installed leads. However, if a new circuit is required to operate the equipment, or if the size of the supply conductors need to be increased, this will be considered new work
(11) No electrical permit shall be issued for a building or structure under the jurisdiction of the department until the building permit has been issued for said building or structure or it has been determined that a building permit is not required or special circumstances exist which make issuance of the permit appropriate.

24.301.441 COVER (ROUGH-iN) INSPECTIONS
(1) Cover (rough-in) inspections are made by a state electrical inspector wherever possible. Insulation and wallboard shall not be applied before inspection unless 48 hours, excluding Saturdays, Sundays, and holidays, have expired after notice to inspect has been received.
(2) Whenever violations are found upon inspection, the inspector will notify the installer verbally or with a written compliance order as to the nature of the violations.

24.301.451 FINAL INSPECTION (1) Upon final inspection, the state inspector will date and sign the inspection permit, either approving or disapproving the installation. If the installation is disapproved, notice thereof, together with reasons for disapproval, will be given by the inspector to the installer. After removal of the cause of disapproval, the installer must make a request for re-inspection of the inspector, and upon payment of a re-inspection fee, as provided in ARM 24.301.461, and approval of the inspector, the inspector will issue an approved inspection permit, and so tag the installation.

24.301.461 ELECTRICAL INSPECTIONS FEES (1) For fee schedule, see Electrical Permit Application.

(2) If the application for permit and the proper fees, as determined under subsection (1) of this rule, are not sent to the electrical safety section prior to or upon commencement of the electrical work, the fees will be doubled and will have to be paid before the permit will be issued.

(3) The fee for a requested electrical inspection is $40, provided that such service is not in excess of 1 hour in duration, and then $20 for each 30 minutes or fractional part thereof in excess of 1 hour. Travel and per diem will also be charged at the rates established under Title 2, chapter 18, part 5, MCA.

24.301.471 TEMPORARY ELECTRICAL CONNECTIONS (1) Except as provided in subsections (2) through (4) of this rule, power suppliers may not energize electrical installations without an inspection and approval of the installation by an electrical inspector employed or approved by the bureau.

(2) Upon receipt of the power supplier copy of the electrical permit, a power supplier may make a temporary electrical connection prior to the inspection and approval of the electrical installation by an electrical inspector employed or approved by the bureau.

(3) Upon receipt of a properly completed Power Supplier Limited Service Certificate (a four-part form supplied by the bureau), a power supplier may make a temporary electrical connection prior to receiving the power supplier copy of the electrical permit and prior to the inspection and approval of the electrical installation by an

electrical inspector employed or approved by the bureau. After making a temporary electrical connection on a Power Supplier Limited Service Certificate, the power supplier shall remit a copy of said certificate to the bureau within three (3) days (excluding weekends and holidays).
(4) As provided by 50-60-605, MCA, no temporary electrical connection made under subsections (2) or (3) of this rule may exceed 14 days. If the 14-day time period elapses without an inspection and approval of the electrical installation, the power supplier must, upon written notification by the bureau or the bureau employed or approved electrical inspector, immediately disconnect any temporary electrical connection made under subsections (2) or (3) of this rule.

8.70.409 CARNIVALS, FAIRS, OUTDOOR CONCERTS AND SIMILAR AMUSEMENT ESTABLISHMENTS, AND OTHER PUBLIC ASSEMBLIES OF A TEMPORARY NATURE
(1) Temporary electrical power and lighting installations may be permitted for a period not to exceed 30 days The installation must comply with Article 305 of the National Electrical code.
(2) The electrical inspection fee for each temporary installation shall be $40 for the entirety of the temporary installation, provided that such inspection can be completed within one hour. If additional inspection time is required, it will be charged at the rate of $20 for each additional 30 minutes or fractional parts thereof.
(3) Each time a temporary amusement or public assembly electrical installation is erected or relocated, another electrical inspection will be required.
(4) The major areas of concern include but are not limited to:
(a) All exterior boxes, cabinets, panels, controls, outlets and switches shall be weather proof.
(b) All cords, wire, etc. shall be approved by a recognized testing agency and in good repair.
(c) All grounding shall comply with articles 250, 445 and 525 of the National Electrical Code.
(d) All cords, caps, and plugs shall be of the grounding type.
(e) All panels, boxes, and cabinets shall have all unused openings plugged.
(f) All panels, boxes, cabinets, outlets, and switches shall have covers, dead fronts or doors.
(g) All electrical equipment shall have physical protection where necessary.

(h) All splices in electrical wires must occur in approved boxes, apparatus or equipment.
(i) All open conductors, open front panels, boxes, switches, etc. must be adequately protected from pedestrian and vehicular traffic, or made inaccessible to the public.

24.301.491 REFUNDS OR CREDITS (1) No permit fee shall be refunded nor credit issued for a permit if the value of the permit does not exceed twenty-five ($25.00) dollars.
(2) A permit with a value which exceeds twenty-five ($25) dollars may be refunded or credited, at the discretion of the bureau, less the twenty-five ($25) dollar refund/credit fee.
(3) A refund or credit issued for a permit fee on a project, which was inspected by the bureau, shall have the refund or credit prorated at the rate of twenty-five ($25) dollars per required inspection performed, in addition to the twenty-five ($25) dollar refund/credit fee.
(4) No refund or credit for permit fees shall be issued for duplicate permits, when the permittee failed to transfer the original permit pursuant to ARM 24.301.431(9) and a subsequent permit was obtained for the same project.
(5) The bureau may suspend or revoke a permit when the permit was issued in error or issued on the basis of incorrect information. Suspended or revoked permits shall not be issued a refund or credit.

Clarification of NEC

Interpretations and Requirements Based on the 2002 NEC

1. Poles/Pedestals as Structures – Article 225.31 and 225.32. When the service from a power supplier is mounted on a pole or delivered to a pedestal containing an overcurrent device and disconnecting means, the pole or pedestal is considered to be a structure and the service point. The wires between the pole or pedestal and the other structures on the property are feeders and a disconnect is required on each structure (Article 225.31). The point of entry may be in a crawl space provided the cable is properly buried in conduit (Article 300.5(C)) beneath the structure. The panel is to be located as close as practicable to the point of entry on the first floor level, directly above the point of entry in the crawl space. Panel placement shall meet all other applicable code requirements. Concrete encasement is not a requirement for protection of a feeder. All grounding and bonding requirements shall apply (see Article 250).

2. Six (6) Disconnect Rule – Article 230.71(A) and 225.33(A). The six (6) disconnect rule shall apply to a structure as well as the service when multiple structures are on the property. The removal of extra bussing in an enclosure is not required even though more than six (6) disconnects could be installed. If six (6) or fewer disconnects are installed, the installation may be approved. When future installations are connected to the panelboard, creating more than six (6) disconnects, a panel main disconnect shall be installed.

3. Feeders from Service Point – Article 240.21. Feeders are to be protected at their source, unless otherwise permitted as per Article 240.21(A) through (G). When a pole or pedestal is used as a service point, all wiring beyond this point on the property is a branch circuit or feeder.

4. Multiple Structure Grounding – Article 250.32. It is recommended that an equipment grounding conductor (green or bare copper 4^{th} wire) be installed with the feeder between multiple structures fed from a common service located on the same property (250.32(B)(1)). It is permissible to install a 3-wire feeder to multiple structures on the same property when there are no common metallic pathways (gas piping, water piping, telephone, cable TV, or other systems) between the structures (250.32(B)(2)). You may be required to install the equipment grounding conductor when a metallic pathway is added at a later date. A grounding electrode system is required at each structure for either system, unless the structure supply is a single branch circuit (Article 250.32(A) Exception).

5. Grounding of Ranges and Clothes Dryers - Articles 250.134 and 250.138. All new installations for electric ranges and clothes dryers shall utilize an equipment grounding conductor to ground the frames of the equipment. This will require the installation of 4-wire receptacles when the appliance is cord connected. The bonding jumper in the appliance must be removed when the appliance is connected to the electrical system.

6. Bonding of Service Equipment - Article 250.92. All metallic raceways and enclosures of the service shall be bonded together by methods listed in section 250.92(B). The service equipment ends at the enclosure that contains the service disconnect. A raceway used to enclose a feeder or branch circuit is not required to meet the service enclosure bonding requirements (Article 250.96).

7. Bonding of Water Piping and Exposed Structural Steel – Article 250.104(A) and (C). The metallic water piping system and any exposed structural steel inside a building shall be bonded with a conductor sized per Table 250.66 when the service

is mounted on the building. In a building fed by a feeder, the conductor shall be sized per Table 250.66 based on the size of the feeder. Due to the various types of water piping materials in use today, both the hot and cold water piping systems shall be bonded together.

8. Metal Gas Piping and Other Metallic Piping Systems – Article 250.104(B). An equipment grounding conductor sized per Table 250.122 shall bond all other metallic piping inside the building. The equipment grounding conductor run with the branch circuit to the equipment may be used for the bonding purpose.

9. Second Grounding Electrode – Article 250.56. Due to the varied soil conditions found in Montana, a single grounding electrode does not insure that a "25 ohms or less" to ground is established. The installer may perform and furnish written test results (including Test diagrams), acceptable to the electrical inspector, in lieu of installing a second grounding electrode. This requirement is only applicable when electrodes described in Article 250.52 (A) (5) or (6) (rod, pipe, or plate) are the sole electrodes used. Electrodes described in Article 250.52(A)(1),(2),(3),(4) (intentionally grounded steel, ground ring, rebar in footing, or water pipe with two (2) supplemental electrodes) do not require the above referenced verification.

10. Bonding of Electrode Enclosures – Article 250.64(E). Metallic raceways enclosing grounding electrode conductors shall be bonded at both ends to the grounding electrode conductor or the buss or electrode to which it is connected. This will eliminate an electrical choke effect. We suggest that you use PVC or staple a #6 or larger copper conductor directly to the surface of the structure. See Article 250.102(C) for acceptable methods of bonding.

11. Free Conductor at Outlets – Article 300.14. Six (6) inches of free conductor shall be left at each outlet, junction, or switch point. The measurement shall be from the point at which the conductor enters the box and there shall be at least three (3) inches of conductor extending outside the box.

12. Box Fill – Article 314.16. The numbers of conductors allowed in a box (box fill) shall be calculated in accordance with the guidelines set forth in this article. Box fill (capacity) is established in relation to the cubic inches in the box, conductor quantity, conductor size, fittings in the box, and the device used. The wire count(s) placed inside the box normally do not include the equipment grounds and devices.

13. Appliance and Electric Heat Disconnects – Article 422.30 and 424.19. A branch circuit disconnect may be used for the required disconnect when in sight of the appliance (not more than 50 feet from) or equipped with an individual lockout, otherwise, a disconnect shall be at the appliance location. A double pole disconnect is required for electric heat of various types. The thermostat with a marked off position may be used as the disconnect for the heating equipment when it opens all ungrounded conductors and there is another disconnect ahead of it in the circuit.

14. Disconnect at Dispensing Equipment – Article 514.11. (A)A switch or circuit breaker is required to disconnect simultaneously all conductors of all circuits leading to or passing through classified fuel dispensing equipment. This includes lighting circuits, sign circuits, or other conductors passing through the dispenser, including the grounded conductors. (B)An emergency disconnect is required not more than 100 feet from the dispenser(s) at an attended self-fueling station. (C)An emergency disconnect located between 20 and 100 feet from the dispenser(s) and an additional emergency disconnect on each island or group of dispensers are required at an unattended self-fueling station.

15. Wiring methods for Fire Rated Buildings – Article 518.4. The selection of a wiring method for places of assembly is not determined solely by the "100 or more occupancy" criteria. Article 518.4(B) allows for the use of romex and other wiring methods in areas that are not fire-rated. Certain buildings with occupancy of up to 300 persons may not be required to be fire-rated. The building code official having the jurisdiction shall establish the type of occupancy and construction for each building or structure. These assigned ratings will

need to be considered in choosing a wiring method that will meet the code requirements.

16. Size of Manufactured (Mobile) Home Feeders – Article 550. Feeders to manufactured homes are not required to be larger than the service entrance conductors (215.2(A)(4)).

17. Manufactured (Mobile) Home Skirting – Feeder Protection – Articles 550 and 300.5(D). The feeder under a manufactured (mobile) home shall be protected from physical damage. The "skirting" of a manufactured home is not a raceway or electrical enclosure. Where not specifically addressed in Article 550, the underground feeder to a manufactured home is governed by the general rules in Chapters 1-4 of the National Electrical Code. Conductor raceways and enclosures are required under a manufactured home the same as required on any other emerging underground conductors.

18. Manufactured (Mobile) Home Panel – Additional Equipment – Article 550.32(D). The manufactured (mobile) home service equipment shall contain a means for connecting accessory buildings, structures, or electrical equipment located outside the home by a fixed wiring method. This does not prohibit the connection of additional exterior equipment to a manufactured home interior electrical panel. Additional loads connected to the home panel shall be calculated to insure the panel and feeder have the capacity to supply the additional loads. The requirements found in Article 550 shall supersede the requirements found in other parts of this code.

19. Bonding of Pools – Article 680.26(C). All portions of a pool required to be bonded shall be bonded using "listed" pressure connectors or clamps of stainless steel, brass, copper, or copper alloy.

20. Spas and Hot Tubs – Article 680.44. A ground-fault circuit interrupter for personnel shall protect all spas and hot tubs.

Questions and Answers

The following is a general guide for the homeowner who is wiring his/her own single family dwelling. It is not intended to take the place of or cover all the possibilities allowed by the 2002 National Electrical Code. For further assistance contact your local inspector.

The Electrical Service

1. What does the owner provide for an overhead electrical service?

The owner provides a weatherhead, mast, and hub attaching the mast to the meter/main panel and three (3) conductors properly sized for amperage. The mast needs to be of rigid conduit if it supports the Power Company supply line (drop) or extends above the roof. Check with your power supplier for their required size and type of conduit to be used for the mast. In addition, ground rods, ground wire and clamps are required.

2. What are the required clearances for an overhead service?

The power company supply line (drop) shall be a minimum of 8’ over flat roofs, 10’ over pedestrian walk areas, 12’ over other residential property, and 18’ over alleys, public streets, and swimming pools. In addition, the drop shall be at least 10’ laterally from the edge of the swimming pool and 3’ laterally from a window used for egress, or a balcony.

3. What does the owner provide for an underground service?

The owner provides an underground meter/main panel and schedule 80PVC electrical conduit. The PVC conduit with connectors, locknut, and bushings at each end, extends 18” into a 24” deep trench. The underground wire is buried a minimum of 24”. In addition, ground rods, ground wire, and clamps are required.

4. Where can the service equipment be located?

Check with your power supply company to determine the direction your power company supply line (drop or lateral) will come from. The meter can be in the yard or on a building, even possibly a mobile home. According to most utility standards, the meter will need to be located between 5' and 6' from the ground level.

Table A – Service and Feeder Sizes

Amperage	Wire Size	Pipe Size
Copper THWN		
100	4	1"
125	2	1"
150	1	1 ¼"
200	2/0	1 ½"
Aluminum THWN		
100	2	1"
125	1/0	1 ¼"
150	2/0	1 ½"
200	4/0	2"

Meters and Mains

1. Where should the main disconnect be located?

The main disconnect needs to be located on the outside of the building or at the point where the conductors enter the building.

2. Do I need a main disconnect at each building if I have a meter/main in the yard?

Yes, you still need a main disconnect at each building. If the house panel is not on an outside wall, you may bury PVC conduit 18" deep in the crawl space before coming straight up into the panel on the first floor level. If URD or USE conductors are used they need to be buried 24" deep outside the house. Do not run the feeder conductors in piping horizontally through the crawl space area without the disconnect being mounted on the outside of the structure.

3. What are the requirements for the feeder wires from the meter/main on the outside of the house to the breaker panel inside?

The feeder size needs to match the amperage on the breaker. The four (4) conductors shall be in conduit or a SER cable. Conductors, locknuts, and bushings are required at each end. The feeder requires support every 4' and within 12" of a connector. The SER cable shall be installed in a wall or ceiling for protection. All aluminum wire requires coating with a deoxidizing agent at all terminals and connections.

Grounding and Bonding

1. Where do the ground and neutral wires get bonded together?

The ground wires and neutral wires are bonded together at the service disconnect and at the building disconnect when the feeder to the building does not contain a ground (4^{th})wire.

2. What is the most commonly used grounding electrode system?

The best grounding electrode is the rebar in the footing that is placed below frost level. A number 4 copper wire can be attached with a rebar clamp and encased in the concrete up to the service panel. In addition, a ground wire also attaches to the metal water piping system, which has direct contact with the earth for a minimum of 10'. The connection is made within the first 5' of where the water piping enters the home. Refer to item 9 of "Interpretations and Requirements" for supplemental requirements if you have only the water pipe. A ground wire is attached with an acorn shaped clamp to a driven (5/8 X 8') ground rod. In the event of no metal water piping system or rebar connection, two driven ground rods shall be installed at least 6' apart and then connected with a #6 copper wire.

3. In addition to the grounding electrode system, what other bonding is required?

The hot and cold metal water piping inside the home is to be bonded to the service or building disconnects. Well casings and pumps shall be bonded with approved lugs or clamps by the

equipment ground wire in the branch circuit feeding them. All other metal piping systems inside the home are to be bonded by the branch circuit equipment grounding conductor feeding the appliance they are connected to.

4. What size grounding wires do I use?

Table B – Neutral and Ground Wire Sizes

Location to:	Copper/Aluminum			
Amperage	100	125	150	200
Service Neutral	6/4	4/2	3/1	1/00
Ground Rod*	8	8	6	6
Ext. Water Piping	8/6	8/6	6/4	4/2
Rebar*	8	8	6	4
Int. Water Piping	8/6	8/6	6/4	4/2
Sub-Panel Ground	8/6	8/6	8/6	6/4
Sub-Panel Neutral	6/4	4/2	3/1	1/00
Service Bond Bushing	8/6	8/6	6/4	4/2

*Must use “Copper” only

5. When shall electrical receptacles be grounded?

All new electrical receptacles are to be grounded. If non-grounded receptacles are replaced in locations requiring GFCI protection (i.e. bathroom, near kitchen sink, exterior outlets, etc.) a GFCI shall be installed on the non-grounded circuit.

Breaker Panels

1. Where can breaker panels be located?

The panel has to be accessible and can not be located in a closet, cupboard, or bathroom. Panels require a 30 inches wide by 36 inches in front of clearance from the floor to the top of the panel (6 foot, 6 inches minimum).

2. When is a separate grounding bar required in a panel?

The neutral wires (white) need to be isolated from the ground wires (green or bare metal) in breaker panels that do not contain the main disconnect for that building, or building disconnect panels fed by a four wire feeder. A separate grounding bar must be installed in these panels.

Installation of Wiring

1. What is required to protect Romex (NM-B) wiring?

Stapled wires and bored holes for wiring shall be not less than 1 ¼ inches from the nearest edge of surfaces. When this clearance can not be maintained, “nail plates” shall be installed.

2. What are the support requirements for Romex (NM-B) wires?

Wires are considered supported when run through bored holes. Other wiring shall be stapled or secured every 4 foot 6 inches and within 12 inches of every box which has a connector or within 8 inches of a box without connectors.

3. How much wire should be left in a box to make connections to a device?

Six inches of free conductor shall be left in the box, a minimum of three inches extending past the front of the box, with ¼ inch of the sheathing extending into the box.

4. How many wires and devices (conductors) will fit in a box for switches and outlets?

Some manufacturers print the fill capacity on the back or bottom of the box (plastic). The fill capacity table in the box normally gives the total number of wire counts allowed in the box.

Cubic Inch requirements for Boxes by Wire Size

Cubic Inches for each	#10	#12	#14
Switch	5	4.5	4
Outlet	5	4.5	4
Wire	2.5	2.25	2
All Grounds	2.5	2.25	2

Example #12 wires:

1 Switch ……...4.50
All Grounds…..…….2.25
2- 12 /2 NM- W/ground…….9.00
1- 12/3 NM- W/ground……...6.75
Total Cubic Inches Required….22.5

5. What are the requirements for installing boxes for lights, switches, outlets, and junctions?

Boxes are required to be securely fastened and flush with the final (finished) surface. Junction boxes require covers and shall be accessible. Metal boxes require cable clamps and grounding.

6. Can outlet boxes be installed in the floor?

Only those outlet boxes that are listed for floor installation may be put in the floor.

7. Is there a special box to be used with ceiling (paddle) fans?

The box used to install a ceiling (paddle) fan is a special “listed” box and shall be securely fastened to a strong ceiling joist.

8. How many Romex can be placed in a bored hole?

Bored (drilled) holes may contain no more than three (3) Romex cables that do not fill more than 50% of the hole.

Outlets, Switches, Lights, and Devices

1. What is considered a wall space?

A wall space is an area along the floor line that is not broken by doorways, sliding wall panels, or fireplaces. A fixed glass panel in a wall or an open railing area in a loft, that is used as a wall in the room, will be considered as wall space for the purposes of determining the spacing of outlets.

2. Where are general electrical outlets required?

Every kitchen, dining room, bedroom, living room, family room, and similar location shall have a receptacle outlet located so that no point along the floor line is more than six (6) feet measured horizontally from an outlet, with no more than twelve (12) feet allowed between outlets. Any wall space longer than two (2) feet requires a receptacle outlet.

3. Can electrical outlets be located above electrical baseboard heaters?

No, electrical outlets cannot be located above electric baseboard heaters. The outlets on these walls need to be arranged to meet the spacing requirements for receptacles. Outlets must be fed from circuits that do not feed the heaters. Most manufacturers make replacement end caps for their heaters with outlets built into them.

4. What is required for bathroom outlets?

In dwelling units, all bathroom receptacles shall be GFCI protected. At least one receptacle outlet shall be installed on a wall within three (3) feet of each basin location. One or more 20 amperes dedicated branch circuits (no other items on these circuits), or 20 amperes dedicated branch circuits supplying only items in a single bathroom, may supply these receptacles.

5. What are the wiring requirements for kitchen outlet circuits?

A minimum of two (2) 20 amperes dedicated circuits are required for the counter space receptacle outlets for small appliance use in the kitchen. These circuits may also feed dining and pantry area receptacles or a clock outlet in the room. No lights, hoods, or other room or outside outlets may be on these circuits. All receptacles in the kitchen serving the countertop are required to be GFCI protected.

6. Where are the receptacles required to be located for the kitchen counter?

Electrical outlets are required to be spaced so that no point along the counter wall line is more than two (2) feet from an outlet. They shall be located no more than eighteen (18) inches above the countertop. A counter space twelve (12) inches or greater requires an outlet.
Peninsular counter spaces of more than twelve (12) inches in length from the connecting edge require at least one receptacle outlet for each work area.
Island countertops of more than twelve (12) inches in length require at least one receptacle for each work area.
Outlets shall not be located more than twelve (12) inches down from the countertop surface.

7. Can I connect a refrigerator to the kitchen counter outlet circuits?

You may supply a receptacle outlet for the refrigerator from the kitchen countertop outlet circuits. An individual branch circuit that feeds only a refrigerator may be installed with a 15 amperes breaker.

8. What are the laundry area requirements?

You are required to install a dedicated 20 amperes circuit for the laundry equipment. There can be no other outlets or lights on this circuit. Outlets for the electric iron or gas dryer are allowed as part of this circuit. If the laundry is located in the bathroom, GFCI protection is required for this circuit.

9. What are the outdoor outlet requirements?

At least one receptacle outlet shall be located on the front and the back of the house. All regular use outdoor outlets are required to be GFCI protected regardless of their location. Ground Fault Protection of Equipment (GFPE) shall be provided for outlets used solely for snow melting equipment. This is a different device than what is used for personnel protection (GFCI).

10. What are the requirements for garages?

A minimum of one GFCI protected outlet and one light on a switch shall be installed in a garage that is attached or furnished with electrical power. Any additional receptacles installed for use with hand tools or portable equipment shall be GFCI protected. Single opening receptacles or duplex receptacles are not required to be GFCI protected when all openings are utilized for stationary permanently connected appliances.

11. What are the requirements for basements?

Finished areas of a basement are to meet all the requirements for receptacle placement and lighting as required for other finished portions of the home. A minimum of one light on a wall switch and one GFCI protected outlet, in addition to any provided for laundry equipment, shall be located in an unfinished basement. GFCI protection is required on all receptacles in unfinished areas of the basement not intended as habitable rooms and limited to storage areas, work areas, and the like.

12. What are the hallway requirements?

At least one receptacle outlet shall be installed in any hallway longer than ten (10) feet in length.

Lighting Requirements

1. Where is exterior lighting required?

Exterior lighting is required at all entrances or exits, except vehicle garage doors. All exterior lighting shall be controlled by a local wall switch, or a remote, central, or automatic switch.

2. When is three-way switching required?

At least one switch is required to operate one lighting fixture or one switched receptacle in each habitable room. When there are more than six (6) steps separating levels of the home, a three-way switch is required at both the top and bottom of each stair section between levels of the home. A landing with an entry/exit door is considered a level of the home.

3. What's required in an attic or crawl space?

In attics or crawl spaces used for storage or that contain equipment that require servicing, at least one light on a switch and one receptacle shall be installed. GFCI protection is required for outlets located in crawl spaces.

4. What are the clearances for a light located in a closet?

The storage area in a clothes closet is the area directly above a shelf to the ceiling, and the area the clothing hangs in below a shelf. A surface mounted enclosed incandescent fixture must be at least twelve (12) inches from this storage area. Recessed fixtures with lenses and surface mounted fluorescent fixtures must be at least six (6) inches from this storage area.

GFCI and Arc Fault Protection

1. Where is GFCI protection required?

GFCI protection is required on all power feeds to a spa or hot tub and for all outlets:

1. serving kitchen counters
2. within six (6) feet of wet bar sinks
3. in bathrooms
4. in crawl spaces
5. in work or storage areas in a basement
6. in garages
7. outdoors
8. in detached storage or work shops

2. How is GFCI protection provided?

GFCI protection shall be provided by a GFCI breaker or the installation of a GFCI receptacle in the first receptacle on the circuit.

3. Where is arc-fault protection required?

Arc-fault protection is required for the entire circuit of all 125 volt outlets in bedrooms. (Receptacles, Lights, Smoke Detectors, Air Conditioners, Heaters, etc.) A breaker shall provide the arc-fault protection.

Hot Tubs and Spas

1. Does a hot tub or spa require an electrical outlet be located near it?

A spa or hot tub shall have at least one (1) GFCI protected outlet located near it. For indoor locations, the outlet is to be located a minimum of five (5) feet away from and a maximum of ten (10) feet away from the tub. For outdoor locations, the outlet is to be located a minimum of ten (10) feet away from and a maximum of twenty (20) feet away from the tub. All additional outlets within the distances described above are required to be GFCI protected.

2. What are the requirements for a light or fan above a spa or hot tub?

The light or fan within five (5) feet of the side of an indoor spa or hot tub shall be protected by GFCI and be at least seven feet six inches (7'6") above the water line. A light or fan within five (5) feet of the side of an outdoor spa or hot tub shall be at least twelve (12) feet above the water line.

Smoke Detector Requirements

316.1 Smoke detectors required. Smoke detectors shall be installed in each sleeping room, outside of each separate sleeping area in the immediate vicinity of the bedrooms, and on each additional story of the dwelling, including basements and cellars, but not including crawl spaces and uninhabitable attics. In dwellings or dwelling units with split levels, a smoke detector need be installed only on the upper level, provided the lower level is less than one full story below the upper level, except that if there is a door between levels, then the detector is required on each level. All detectors shall be interconnected such that the actuation of one alarm will actuate all the alarms in the individual unit and shall provide an alarm, which will be audible in all sleeping areas. All detectors shall be approved and listed and shall be installed in accordance with the manufacturer's instructions.

316.1.1 Alterations, repairs, and additions. When alterations, repairs, or additions requiring a permit occur, or when one or more sleeping rooms are added or created in existing dwellings, the entire building shall be provided with smoke detectors located as required for new dwellings. The smoke detectors are not required to be interconnected, unless other remodeling considerations require removal of the appropriate wall and ceiling coverings to facilitate concealed interconnected wiring.

316.2. Power source. Required smoke detectors shall receive their primary power from the building wiring when such wiring is served from a commercial source, and when primary power is interrupted, shall receive power from a battery. Wiring shall be permanent and without a disconnecting switch other than those required for overcurrent protection. Smoke detectors may be battery operated when installed in buildings without commercial power.

Summary

1. In each sleeping room
2. In general area outside of sleeping rooms
3. Electrically powered
4. Battery backup
5. Interconnected (simultaneous alarm)
6. On each floor level

1. Are Smoke detectors required to be on a separate circuit?

No, they can be placed on any general wiring circuit. They are not to be placed on any of the required dedicated circuits.

2. How are electric smoke detectors to be wired?

Electric smoke detectors shall be wired in a series with power to the first unit. Three (3) conductor cable with ground will be run from it to the remaining units. Follow the manufacturer's instructions.

Branch Circuits

Equipment and Location	Breaker	Wire	Special
Kitchen counter outlets	20 amp	12	1,2, note
Dishwasher	15/20	14/12	1,5,6
Garbage disposal	15/20	14/12	5,6
Range hood	15/20	14/12	5
Microwave	20	12	1,5,6
Stove	40/50	8/6	1,5,6
Double oven	40/50	8/6	1,5,6
Single oven	30	10	1,5,6
Cooktop	30	10	1,5,6
Washer	20	12	1,6
Dryer	30	10	1,6
Water heater	20/30	12/10	1,5,6
Furnace	15/20	14/12	1,5,6
Electric baseboard heat	15/20/30	14-10	1,5,6
Pump	15/20	14/12	1,5,6
Hot tub or spa	15-50	14-6	1,2,5,6
Air conditioner	15-50	14-6	1,5,6
Exhaust fan	15/20	14/12	5
General purpose outlets	15/20	14/12	Note
General purpose lights	15/20	14/12	Note
Bar sink outlets	15/20	14/12	4,Note
Bathroom outlets	15/20	14/12	1,2,Note
Garage outlets	15/20	14/12	2,Note
Bedrooms	15/20	14/12	3,Note
Outside outlets	15/20	14/12	2,7,Note
Unfinished basement outlets	15/20	14/12	2,Note

Special Requirements

1. Separate dedicated circuit
2. GFCI protection required
3. Arc-fault protection required
4. GFCI protection required within six (6) feet
5. See manufacturer's instructions
6. Disconnect is required near appliance or lock-out in breaker panel. Disconnect may be a cord connection where allowed.
7. In use type weatherproof receptacle cover required in wet locations.

Note: Maximum number of outlets or lights on a 15 amp circuit is 10. Maximum number of outlets or lights on a 20 amp circuit is 13.